DPP
DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 4

Topic :- MOTION IN A PLANE

1 **(d)**

Centripetal force $F = -\frac{k}{r^2}$

$\frac{mv^2}{r} = \frac{k}{r^2} \Rightarrow mv^2 = \frac{k}{r}$

Kinetic energy $= \frac{1}{2}mv^2 = \frac{k}{2r}$

Since the centripetal force is a conservative force, and for a conservative force,

$F = \frac{dU}{dr} \Rightarrow U = -\int F \, . \, dr$

$U = \int \frac{k}{r^2} dr = -\frac{k}{r}$

Toatal energy $= K + U = \frac{k}{2r} - \frac{k}{r} = -\frac{k}{2r}$

2 **(d)**

$\vec{A} \times \vec{B} = (\hat{i} - 2\hat{j} + 3\hat{k}) \times (3\hat{i} - 2\hat{j} + \hat{k})$

$= -2\hat{k} - \hat{j} - 6(-\hat{k}) - 2\hat{i} + 9\hat{j} - 6(-\hat{i}) = 4\hat{i} + 8\hat{j} + 4\hat{k}$

Modulus is $\sqrt{4^2 + 8^2 + 4^2} = \sqrt{32 + 64}$

$= \sqrt{96} = 4\sqrt{6}$ units.

3 **(b)**

$\hat{n} = \frac{\vec{A} \times \vec{B}}{AB\sin\theta} = \frac{A\hat{A} \times B\hat{B}}{AB\sin\theta} = \frac{\hat{A} \times \hat{B}}{\sin\theta}$

4 **(c)**

Horizontal range $R = \frac{u^2 \sin 2\theta}{g}$

Substituting the given values we get

$560 = \frac{82 \times 82 \times \sin 2\theta}{9.8}$

$\Rightarrow \sin 2\theta = \frac{560 \times 9.8}{82 \times 82} = \frac{5488}{6724}$

$\Rightarrow \sin 2\theta = 0.82 \Rightarrow 2\theta = \sin^{-1}(0.82)$

$\Rightarrow 2\theta = 55.1° \Rightarrow \theta \approx 27°$

5 **(c)**

From $v = r\omega$, when v is doubled and ω halved, r must be 4 times. Therefore, centripetal acceleration

$= \frac{v^2}{r} = r\omega^2$ will remain unchanged

6 **(d)**

Angular momentum is an axial vector. It is directed always in a fix direction (perpendicular to the plane of rotation either outward or inward), if the sense of rotation remain same

8 **(c)**

$R_{\max} = \frac{u^2}{g} = 100 \Rightarrow u = 10\sqrt{10} = 32\ m/s$

9 **(a)**

Maximum height, $H = \frac{u^2 \sin^2\theta}{2g}$

Range, $R = \frac{u^2 \sin 2\theta}{g}$

Given, $H = \frac{R}{2}$

$\therefore \frac{u^2 \sin^2\theta}{2g} = \frac{u^2 2\sin\theta\cos\theta}{2g}$

or $\sin\theta = 2\cos\theta$

or $\tan\theta = 2$

or $\theta = \tan^{-1}(2)$

10 **(b)**

$v = r\omega = 0.5 \times 70 = 35 m/s$

11 **(a)**

In uniform circular motion the only force acting on the particle is centripetal (towards centre). Torque of this force about the centre is zero. Hence angular momentum about centre remains conserved.

12 **(a)**

Horizontal velocity of aeroplane,

$u = \frac{216 \times 1000}{60 \times 100} = 60\ \text{ms}^{-1}$

Time of flight, $T = \sqrt{\frac{2s}{g}} = \sqrt{\frac{2 \times 1960}{9.8}} = 20\text{s}$

Horizontal range, $AB = uT$

$= 60 \times 20 = 1200\text{m}$

13 **(d)**

$\sqrt{P^2 + Q^2 + 2PQ\cos\theta} = (P - Q)$

$\Rightarrow P^2 + Q^2 + 2PQ\cos\theta = P^2 + Q^2 - 2PQ$

$\Rightarrow 2PQ(1+\cos\theta)=0$

but $2PQ \neq 0$

$\therefore 1 + \cos\theta = 0$ or $\cos\theta = -1$

or $\theta = 180°$

14 **(b)**

Range $= \frac{u^2 \sin 2\theta}{g}$. It is clear that range is proportional to the direction (angle) and the initial speed.

15 **(a)**

Displacement, $\vec{r} = (\vec{r}_2 - \vec{r}_1)$ and workdone $= \vec{F}.\vec{r}$

16 **(a)**

From $F = -\frac{dU}{dr}, dU = -F\,dr$

$U = \int -F\,dr = \int \frac{K}{r^2} dr = -\frac{K}{r}$

$\text{KE} = \frac{1}{2}\text{PE} = \frac{K}{2r}$

Total energy $= \text{KE} + \text{PE}$

$= \frac{K}{2r} - \frac{K}{r} = -\frac{K}{2r}$

17 **(a)**

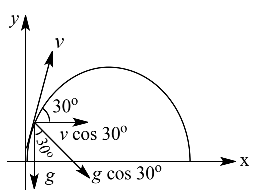
$\vec{F} = F_x\hat{i} + F_y\hat{j}$ or $\vec{F} = 2\hat{i} - 3\hat{j}$.

18 **(d)**

$h = \frac{5}{2} r \Rightarrow r = \frac{2}{5} \times h = \frac{2}{5} \times 5 = 2\ metre$

19 **(c)**

Let v be the velocity of particle when it makes 30° with horizontal. Then



$v \cos 30° = u \cos 60°$

or $v = \frac{u \cos 60°}{\cos 30°} = \frac{20\left(\frac{1}{2}\right)}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{20}{\sqrt{3}} \text{ms}^{-1}$

Now, $g \cos 30° = \frac{v^2}{R}$

or $R = \frac{v^2}{g \cos 30°} = \frac{\left(\frac{20}{\sqrt{3}}\right)^2}{(10)\,\frac{\sqrt{3}}{2}}$

= 15.4 m

20 **(d)**

$p = mv \cos\theta$

$= 1 \times 10 \times \cos 60° = 10\left(\frac{1}{2}\right) \text{kg ms}^{-1} = 5 \text{ kg ms}^{-1}$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	D	D	B	C	C	D	A	C	A	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	A	D	B	A	A	A	D	C	D